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ABSTRACT

This study was designed to explore changes in students' problem-solving skills as they analyzed instructional design case studies during a semester-long course. Nineteen students at two Midwestern universities analyzed six to ten case studies as part of their course assignments. Both quantitative and qualitative data were collected, with students' written case analyses (initial conceptualizations and recommended solutions) serving as the primary data source. Comparisons were made both within and across students, as well as across time, to examine patterns and changes in students' problem-solving approaches. Findings suggest that students could show expert characteristics at times and under some circumstances, but did not perform like experts on a regular basis. The primary influences on the incidence of expert performance seemed to be more external than internal and might be characterized as "coached expertise." Specific suggestions for supporting the development of students' problem-solving skills within a case-based course are included. (Author/JM)

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Case-based instruction in post-secondary education: Developing students' problem-solving expertise

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Case-based instruction in post-secondary education:

Developing students' problem-solving expertise

This exploratory study was designed to examine changes in students' problem-solving skills as they analyzed instructional design case studies during a semester-long course. Nineteen students at two midwestern universities analyzed six to ten case studies as part of their course assignments. Both quantitative and qualitative data were collected, with students' written case analyses (initial conceptualizations and recommended solutions) serving as the primary data source. Comparisons were made both within- and across-students, as well as across-time, to examine patterns and changes in students' problem-solving approaches. Findings suggest that students could show expert characteristics at times, under some circumstances, but did not perform like experts on a regular basis. The primary influences on the incidence of expert performance seemed more external than internal and might be more aptly characterized as "coached expertise." Specific suggestions for supporting the development of students' problem-solving skills within a case-based course are included.

Expertise has been a subject of study for years. For example, based on their studies of telegraphers, Bryan and Harter (1899) argued that experts develop a system of "higher habits" that become automatic, allowing them to accurately handle large amounts of information. Over the years, expertise has been examined in areas as diverse as chess (Chase & Simon, 1973), baseball (Chiesi, Spilich, & Voss, 1979), physics (Chi, Feltovich, & Glaser, 1981), nursing (Benner, 1984), music (Sloboda, 1976), troubleshooting electronic equipment (Johnson, 1988), and instructional design (LeMaistre, 1998; Perez & Emery, 1995). This research has consistently found that, compared to novices, experts are able to more quickly arrive at better solutions to a wider variety of problems within their area of expertise. Experts are able to do this because they approach the problem-solving task differently. Experts are more likely than novices to:

- Represent the problem conceptually. While novices tend to perceive a problem in terms of its surface details, experts look for the "big picture" and represent the problem (often graphically) in terms of an appropriate underlying principle, an ability that Larkin (1979) called "low detail reasoning" (pp. 115-116)
- Work forward from what they know. While novices tend to work backward to fill in what they don't know, experts work forward, building on what they do know, generating hypotheses and looking for additional information in order to test those hypotheses.
- Simultaneously consider multiple factors. While novices tend to consider one factor at a time, in isolation from other factors, experts consider the web of relationships and interactions that exist in the problem situation. They tend to view these as mutually interdependent parts of a system that must be considered in concert.
- Generate tentative solutions early. Like novices, experts tend to float trial solutions early in the problem-solving process. Unlike novices, however, experts brainstorm multiple solution ideas and frequently modify or eliminate solutions as additional information becomes available.

- Think about implications. While novices tend to make recommendations without regard for potential consequences, experts tend to think through their recommendations, considering how those recommendations might be implemented and what implications they might have.

These characteristics of experts are well established in the literature. In addition, several authors have suggested that expertise develops gradually, over an extended period, and along a predictable path (Bereiter & Scardamalia, 1993; Bloom, 1985; Dreyfus & Dreyfus, 1986). A consistent view is that it takes as much as 10 years of experience to develop expertise (Ericsson, 1996). Like many developmental progressions, the growth of expertise exists along a continuum. "Novice" and "expert" are overlapping, rather than discrete, categories. In addition, individuals will move along the continuum at different rates. And, to complicate things further, expertise is not based solely on experience. Bereiter and Scardamalia (1993) described an "experienced nonexpert" as someone who approaches problems in novice-like ways despite having extensive experience. In contrast, experts are those individuals who use their experience to represent problems conceptually, work forward from what they know, simultaneously consider multiple factors, remain open to revising solutions, and think about the implications of their recommendations.

An essential question for postsecondary education, then, is whether this developmental progression can be facilitated through the application of instructional technique. Unfortunately, while the literature provides a clear description of expertise, it offers little in the way of strategies for facilitating its development. Dunn and Taylor (1990) suggested that expertise can not be directly taught, although it can be learned. If this is accurate, then the primary instructional task becomes one of helping students learn to approach problems as experts do. This means providing students with opportunities to apply the problem-solving strategies used by experts, guidance in the use of those strategies, and assistance in monitoring their use of those strategies. One promising way to accomplish these tasks is the use of case-based instruction.

For more than 100 years, case-based instruction (a teaching method in which students analyze and solve realistic problems through reflection and discussion) has been incorporated into professional education as one way of helping students develop expertise (Williams, 1992). For

example, students in law school will read a case study and participate in a dialogue designed to elicit the key issues and legal principles in the case. More than simply recalling information, the students are asked to analyze the situation as a practicing lawyer would. Similar methods are common in both business and medical schools (Albanese & Mitchell, 1993; Christensen, 1987). More recently, the case method has made in-roads into other professions including teacher education (Merseth, 1991), educational psychology and measurement (Welty, Silverman, & Lyons, 1991), and instructional design (Ertmer & Quinn, 1999).

In case-based instruction, the learning focus shifts from the explicit knowledge and skills that form the traditional academic curriculum to creating professional knowledge that allows students to "think like" professionals. Cases are thought to be more effective than didactic teaching methods because they allow for a more accurate representation of expert knowledge and because they explicate the problem-solving processes of both student and expert (instructor). Specifically, case-based instruction can help students:

- Focus on the big picture. In case-based instruction, knowledge is embedded within complex and ill-structured problems. As a result, students have an opportunity to practice "spotting" the underlying issues and principles in authentic, relevant problems.
- Work forward from what they know. A case study, by necessity, presents an abbreviated view of a problem situation. Students are urged/forced to do the best they can with what is available. Thus, they learn to frame problems in ways that will move them forward toward a solution. According to Fox (cited in Christensen, 1987) cases "provide a most invaluable opportunity to learn how far one can go by rigorous logical analysis on one or another dimension of the problem and the extent to which judgment comes into play when many factors, which have no common denominator, must be weighed" (p. 23).
- Simultaneously consider multiple factors. Cases allow students to experience the "complex and dynamic forces" (Rowland, 1992) that operate within the kind of complex problems that professionals commonly encounter. Although individual students may initially focus

on a single factor when analyzing a case, case discussions tend to bring all of these factors to the table. This facilitates consideration of all factors in an interdependent manner.

- Generate tentative solutions. Case studies tend to involve more than one key player, each representing a unique perspective. With practice, students can begin to understand that each player has a legitimate voice. Students are encouraged to modify their initial solutions as information accumulates and different perspectives are heard, including the student's own perspective. According to Cossom (1991), "Participants do not necessarily expect, but find useful, the wide divergence of analysis and proposed interventions ... This method often moves students to a new awareness of their own ideological system and causes growth, questioning, or affirmation of this (p. 149).
- Consider potential consequences and implications. As a part of the case discussion, students are asked to consider the consequences of their recommended solutions and to select the one with the greatest benefits and smallest risk. Fellow students and instructors are encouraged to evaluate each others' recommendations and to challenge decisions based on their assessment of the consequences for all case players.

Case-based instruction is not without risk. Blumenfeld, Soloway, Marx, Krajcik, Guzdial, and Palincsar (1991) suggested that "without adequate attention to ways of supporting students and teachers, learning-by-doing will not be done" (p. 374). Shulman (cited in Merseth, 1991) stated that in the hands of an ineffective instructor, "there is no worse method." If not used well, cases may merely perpetuate the approaches and strategies that novices already use and students will not progress toward expertise. Sykes and Bird (1992) noted that "learning from cases will depend on the interaction among what the case presents, what the reader brings, and what the teacher does with the case" (p. 511). Instructors and students, therefore, could benefit from guidance regarding how to teach and how to learn from cases.

This study was designed to examine changes in students' problem-solving skills over the course of a semester in which instructional design (ID) case studies comprised the primary instructional method. We hoped not only to explore ways in which the case method did and did

not facilitate the development of students' problem-solving skills, but also to identify strategies that might enhance the instructional use of cases. Specifically, the purposes of this study were to:

- examine the development of students' problem-solving expertise within a case-based course, including increases in students' perceived competency for discipline-related problem-solving tasks.
- identify and describe strategies for helping students develop their problem-solving expertise through effective interaction with cases, instructors, and peers within a case-based course.

Methods

To examine changes in students' problem-solving skills, both quantitative and qualitative data were collected, with students' individual written case responses serving as the primary data source. Comparisons were made both within- and across-cases (students) to examine patterns in students' problem-solving approaches. Finally, comparisons were made across time to assess changes in students' approaches over the semester.

Role of the Researchers

The researchers were faculty members at a large midwestern university who, in the spring of 1998, cotaught an advanced instructional design course using a case-based approach. One faculty member was serving in a visiting position while on sabbatical from another institution. The following spring semester (1999), both researchers taught similarly structured courses at their respective universities. Due to the exploratory nature of the study and the small number of participants in each class, data were combined from all three classes. By including a greater number and range of students we hoped to identify and describe salient characteristics of students' problem-solving approaches, as well as changes in approaches during a semester-long course.

Description of Site and Participants

Participants (n=19) were enrolled in advanced graduate (n=14) or undergraduate courses (n=5) in instructional design. All but one student volunteered to participate in the study. Two undergraduate students were dropped from the study due to incomplete data sets. Course assignments and procedures were the same for participants and non-participants. Undergraduate

students were enrolled in the 2nd instructional design course within a 12-course curriculum for Human Resource Development majors at a large commuter university in the midwest. Undergraduate students ranged in age from 21 - 24 years, with an average age of 23 years.

Graduate students were enrolled in an elective course in an instructional design program at a large midwestern university and had taken 0 - 6 previous ID courses. Although an Introductory ID course was listed as a prerequisite, 3 students were admitted without the introductory course, having gained sufficient foundational knowledge from previous work experiences. Graduate students ranged in age from 24 - 49 years, with an average age of 35 years.

Students in all three courses had a variety of background experiences including informal and formal training experiences, retail sales, office work, classroom teaching (junior high, high school, community college, university), nursing, course development, and quality analyst/engineer at a local manufacturing plant. In general, the undergraduates had less course work and fewer relevant job experiences than the graduates (see Table 1 for more complete demographic information).

Insert Table 1 about here

Procedures

Students in each course analyzed six to ten instructional design case studies as part of their course assignments. Case studies were drawn from Ertmer and Quinn (1999) and were used in conjunction with other activities (guest speakers, student presentations, project assignments, required readings) throughout the semester. There were no assigned textbooks in the graduate courses, although additional readings were frequently recommended or required. The undergraduate course included a book by Kemp, Morrison, and Ross (1996) as the primary text. Students in the initial graduate course (Spring, 1998) discussed two cases every week (although each student provided a written analysis for only one of the two), while students in the undergraduate course discussed a case study approximately every other week. Students in the second graduate course (Spring, 1999) analyzed and discussed approximately one case per week, including four student-generated cases. The undergraduate course incorporated cases that were connected to reading assignments from the primary text. Cases in the graduate courses were

sequenced randomly in order to enhance students' developing skills in both problem-identification and problem-solving.

Quantitative data collection and analysis

For each case study, students in the Undergraduate and Spring, 1998 Graduate courses completed: (1) an open-ended questionnaire regarding previous experiences with instructional design and with cases, and (2) a 5-point Likert scale indicating perceived level of competency from 1 (weak) to 5 (strong) on 16 instructional design skills (Self-assessment survey). The Self-assessment survey was based on the 16 instructional design competencies outlined by the International Board of Standards for Training, Performance, and Instruction (IBSTPI, 1984). Students rated their current level of knowledge and skill on items such as: conduct a needs assessment, design instructional materials, evaluate instruction/training, design an instructional management system, and promote the use of ID.

At the end of the semester, the Self-assessment surveys were re-administered to all participants. Results were compared via paired t-tests to determine changes in students' perceived levels of ID competency. In general, it was expected that students would perceive themselves as being more competent as they gained more experience with real design situations via case studies.

Qualitative data collection and analysis

For each case study, students in the Undergraduate and Graduate (Spring, 1998) courses were asked to complete two written tasks: (1) to describe their conceptualizations of the case, and (2) to discuss recommended solutions. Graduate students enrolled in the Spring, 1999 course posted their initial thoughts about the cases to a class listserv, and then discussed these ideas prior to their weekly class meetings. Specific directions for listserv postings varied from week to week; sometimes the two questions above were used, other times different questions were used to guide the analysis process. In general, these postings replaced the written tasks completed by students in the other two classes.

Qualitative analysis methods were used to examine changes in students' case responses. The two course instructors independently read and analyzed the first set of case responses (Spring,

1998) using a constant comparison method (Glaser & Strauss, 1967). Responses were initially coded using categories gleaned from the expert-novice literature, as described above, but modified to fit emerging themes and patterns. For example, initial codes were used to characterize students': conceptualizations of the case (big picture vs. surface details), searches for information (forward vs. backward), attention to the relationship among factors (interrelated vs. isolated), levels of commitment to solutions (tentative vs. firm), and consideration of the impact/implications of recommendations (specific vs. general). These codes were refined throughout the analysis process and eventually combined into analysis and solution categories. Recognizing that problem-finding and problem-solving are two related, but different, skills we examined students' analysis and solution approaches separately. We examined students' analysis approaches by looking at their conceptualizations of the case issues, searches for information, and attention to the relationship among issues/factors. We examined students' solution approaches by looking at their attention to the relationship among solutions, levels of commitment to proposed solutions, and consideration of the impact/implications of proposed solutions.

Using these two categories, each researcher assumed primary responsibility for analyzing the case responses for approximately half of the 12 students in the 1999 data set. All analyses were shared and discussed by the researchers. Throughout the analysis process we continued to refine our definitions of the codes and categories, constantly clarifying our understanding of how these expert- or novice-like characteristics were represented within each student's responses. To help us classify students' responses consistently, we identified a few particularly strong "expert" and "novice" examples that seemed to illustrate each category well. These examples, then, guided our continued analysis efforts. Examples of expert and novice responses are included in Appendix A.

In order to compare students' approaches across-case responses, as well as across-courses, we assigned an independent rating to each student's analysis and solution response, using the following criteria. If most of the components of a response were novice-like, the response was rated "weak." If the response included a fairly equal number of novice- and expert-like characteristics, it was rated as a "mix." Finally, if most of the components of the response were

expert-like, the response was rated "strong." This allowed us to compare students' analysis and solution approaches, to identify patterns of responses specific to each case study, and to identify patterns that developed or changed across-time.

Results

A two-tailed paired t-test (df = 18) indicated a significant increase in students' ratings of perceived competency for instructional design skills ($t = 6.69$; $p > .001$) from the beginning to the end of the semester. Even though all 16 skills were not specifically addressed in the case studies that were used in the courses, students judged that their competency had increased across skills (pre-test mean = 3.44, SD = .27; post-test mean = 4.01, SD = .26). However, this increase in perceived competency was not completely supported by corresponding qualitative changes in students' approaches to analyzing cases and recommending solutions. In general, students did not develop in a smooth, predictable progression along the continuum from novice to expert. Instead, they showed both expert and novice characteristics throughout the semester. In fact, sometimes they demonstrated more expertise on an earlier case and less expertise on a later case.

For example, Cindy's third case analysis provided a clear and concise problem statement (expert-like) -- "I believe the primary problem is the inability to use American/Western techniques in non-western cultures." In describing the problem in this way, Cindy interpreted the problem and framed it in terms of the underlying concept of culture. In contrast, Cindy offered no conceptual frame for the problem presented in the fifth case. Instead, she simply restated information from the case (novice-like).

Similarly, Margaret's analysis of the third case centered around a perceived need for additional information about the problem. Margaret proposed a set of hypotheses that "need to be further studied …before final decisions should be made…" These hypotheses provided an organizing framework for her analysis and gave direction to her information search (expert-like). In contrast, Margaret's sixth case analysis simply listed a set of issues recounted from the case. There was no apparent effort to organize or describe them in terms of an underlying principle (novice-like).

This pattern was also noted in students' solution responses; that is, sometimes a student's

solution was more expert on an earlier case than on a later case. For example, Jerry's solution to his first case was intended to convince the management of the company in the case that the effectiveness of a proposed training program should be assessed while it was still being developed. His explanation considered a range of interrelated issues (expert-like), including what different groups within the company he would have to convince, which groups were likely to be "an easy sell," what information to include in his presentation to these groups, and the assessment process itself (sampling, developing the assessment instrument, and the importance of anonymity). In contrast, Jerry's solution for the third case provided less information (novice-like). His recommendations were almost all about what should have been done rather than what could be done now. Stated in this way, the recommendations seemed more like an extension of his analysis than a solution for the current problem.

Similarly, Kim's solution for her second case suggested that more information was needed "to make a clear assessment of the situation." She outlined a detailed plan for obtaining this additional information (expert-like), including consideration of information sources, data-gathering methods, and some specific questions to be asked. In contrast, in her solution for the fifth case, Kim didn't provide the kind of specific information as in the earlier case. She described a brief rationale for her recommendations, noting, for example, that conducting a focus group would "help determine if the problem lay with lack of knowledge or a resistance to the new technology." But, there was little or no information about how to implement her recommendations (novice-like).

Interpretation of Results

One interpretation of the findings described above is that students were capable of showing expert characteristics at times, under certain circumstances, but that they did not do so on a regular basis. Based on our interpretation of the data, we speculate that there were a number of factors that may have contributed to the relative strength of a student's response to a particular case, including: (1) students' previous work and course experiences, (2) feedback received on previous cases within the course, (3) the way the case write-ups were structured for the students (particularly related to the listserv discussions that replaced the individual student analyses), (4) the type of case

being discussed (the setting, aspects of the instructional design process that were involved, etc.), and (5) contextual factors (timing of the case within the semester, events in the students' lives, etc.). These factors may have interacted in many different combinations to influence a student's response. To illustrate how these factors may have combined to influence student performances, we examine two cases that occurred at approximately the same time in the semester. In one case, the presence of these factors appeared to play a positive role. In the other case, the absence of the same factors appeared to play a negative role.

A Strong Response

The Lynn Dorman case was the second case assigned to two of the three student groups (Graduate students, 1999; Undergraduate students, 1999). Briefly stated, this case takes place in a manufacturing plant in which employee accidents have become more frequent. In response to the increased accident rate, the instructional designer has been asked to create a safety training program and, before she designs the training, she is trying to find out why the accident rate has increased. In general, responses to this case were relatively strong, stronger than might be expected for a case this early in the semester. Of the 12 students who analyzed this case, 10 (83%) produced either a strong analysis or a strong solution. Six of these 10 produced both a strong analysis and a strong solution. As a point of comparison, the first case response resulted in no strong analyses or solutions for either group. Furthermore, 7 of the 12 students (58%) produced their strongest response to this case, more than any other case.

The question is: Why did this case produce such strong analysis and solution responses so early in the semester? We propose the possibility that several, if not all, of the factors described above may have combined in some fashion to create a qualitative difference (i.e., more expert-like approaches) in students' responses. We present a few examples of how these factors may have played influential roles. Although somewhat speculative on our part, and thus in need of further study, we offer these suggestions as a first step in identifying both positive and limiting influences on students' problem-finding and problem-solving skills. These then, in turn, might help us identify effective ways to coach the development of these skills by maximizing the positive

influences and minimizing the limiting influences experienced by our students.

Previous experience. Carolyn's response to the Lynn Dorman case was the first of several strong responses for her. Carolyn produced either a strong analysis or a strong solution for 5 of the 6 (83%) cases she analyzed, and in 4 of those cases (67%) she produced a strong analysis and strong solution. This was more than any other student in the 3 groups.

Carolyn's pattern of strong responses may have been influenced by her previous experiences with case-based learning. She was one of several students who reported using cases in previous college courses. However, she was the only student who reported experience with case-based learning in job-related training. As a trainee, she had used cases in training programs dealing with customer service, diversity, and sexual harassment. As a result of this broader experience with cases, Carolyn may have had more practice in the tasks of identifying issues, simultaneously considering multiple issues, and explaining herself with some specifics. In addition, she may have been more confident in her ability to analyze cases and, therefore, more willing to try out her conceptualizations of the problem in a case as well as her recommendations for resolving those problems. Though the content was different in this course, Carolyn's previous experiences with case-based learning may have helped her produce responses that were, in general, more expert- than novice-like.

Mary also produced strong responses (analyses and solutions) for the majority of cases she analyzed (4/7), including the Lynn Dorman case. Although Mary had no previous experiences with case-based learning specifically, she had numerous work-related experiences that appeared beneficial when analyzing these case studies. She had also completed at least six previous ID courses. Specifically related to the Lynn Dorman case, Mary had recently completed an internship at a local manufacturing plant (serving as an instructional designer), and had, at one time, been employed as the personnel manager in a small factory. These work experiences provided her with the "productivity lens" she used to both analyze the issues in this case, as well as to propose solutions (see Appendix A for an excerpt from her analysis). Her understanding of Lynn's situation, based on her own work experiences, gave her insight into the issues Lynn was facing as

well as the means for understanding how to address those problems.

Coaching/feedback. In general, responses to the first case were mostly novice-like. Analyses were often characterized by listing problems that were simply reported from the case, rather than conceptualized in any way. For example, Kim presented a laundry list of "key" issues that took the form of a list of complaints about the people working on the project. These issues were presented as unrelated items with no apparent effort to categorize or prioritize them, reinforcing the idea that Kim was simply reporting the surface details of the case.

Solutions provided for the first case were often characterized by a past orientation (what should have been done), rather than a present orientation (what should be done now), and often included limited information about how to implement the suggestions or about what consequences they might have. For example, Jack's solution didn't say much about how to carry out his recommendations or what effect they might have on the problem. In fact, his recommendations seemed to contradict one another in places, reinforcing the idea that Jack hadn't thought them through in any systematic way.

In contrast, analyses of the Lynn Dorman case were more likely to draw conclusions or form hypotheses about the issues, rather than simply report them. For example, Carolyn used the information in the case to "suspect possible needs" and suggest obtaining additional information about those possible needs. Solutions were more likely to be explained with some detail. For example, Kim outlined a strategy designed to explore several factors that might be influencing the employees' performance on the job. As part of her strategy, she described a number of specific sources of information and specific questions that should be asked.

The students' response to the Lynn Dorman case may have been influenced by the coaching or feedback they received on the first case, which took the form of comments made in the margins of their written assignments and the responses of both the instructor and other students made during the in-class and on-line case discussions. Once they had received feedback on the first case, it is likely that the students had a clearer idea of what was expected from them, and how to structure their responses. As a result, responses to the second case were, in general, much more expert-like

than responses to the first case.

Case content. Chuck's analysis of the Lynn Dorman case specified several issues, all related to "the increase in accidents in the plant" and he provided a mix of recommendations designed to reduce the accident rate. His recommendations included training, but went beyond the original request for training to include communicating and enforcing the existing safety regulations and improving the general cleanliness of the plant. Chuck's response to this case was characteristically action-oriented. Even when he described the issues, he stated them as things to do, and the things to do were virtually all tasks to be carried out by plant management.

Chuck's strong response to this case may have been influenced by the nature of the case -- concern for the accident rate within a manufacturing plant. This was familiar territory for Chuck. He had worked in a manufacturing plant for a number of years and described himself as a "black-belt" in quality assurance. The other cases Chuck analyzed weren't as familiar to him (transportation, banking, accounting, diversity). As a result of his experience in manufacturing, Chuck may have had an easier time placing himself in this situation, thinking about the issues that might help to define the problem, and thinking through suggestions for reducing the problem, all of which combined to help him produce a strong response to this case. Chuck's response on the Lynn Dorman case illustrates how case content may have interacted with relevant work experience to shape a strong response.

Case set-up. Jane's analysis of the Lynn Dorman case was organized around three interrelated issues, including safety and change management. The reference to change management is important because it is less obvious (a deeper issue) than the concern for safety. Jane noted that changes have come at a rapid pace and hypothesized that, as a result, "the workers seem to have developed a somewhat hostile attitude toward their employer's new tactics." In her solution, Jane noted the importance of balancing the interrelated, and potentially conflicting, issues of safety and productivity, describing the instructional designer's main task as determining "a way to decrease plant accidents while not tampering with the production rate." Finally, Jane considered the impact of her recommendations. She suggested, for example, that the instructional designer find out what

kinds of training the employees prefer because doing so will "provide the workers with a sense of control over their training. It will also help to create relevant training practices."

Jane's strong response to this case may have been influenced by the way the case discussion was structured for the students. In assigning the case, the instructor for this group (Graduate, 1999) specifically asked the students to list 2 or 3 issues that were present in the case and, then, later in the week, to identify what they saw as the primary issue with a corresponding solution to address that issue. Jane's response can be seen as following that directive. Furthermore, because this discussion occurred on the listserv, Jane was able to think about, respond to, and incorporate other perspectives on the case. For example, although Jane's initial conceptualization of the case did not include any references to productivity, she responded thoughtfully to Mary's postings and modified her conceptualization to include this important point. Thus, the case set-up for this particular case not only included very structured directions for conceptualizing the case, but also provided opportunities for students to benefit from each other's points of view, via the course listserv. In this way, students served as coaches for each other in terms of broadening their views of the case. In total, 6 of the 7 students in this group (86%) had strong analyses and 5 of those (71%) also had strong solutions, providing further evidence of the positive effects of case set-up.

Contextual factors. Nancy's analysis of the Lynn Dorman case was based on an application of Gilbert's Performance Engineering Model (1996) which provides a systematic approach to determining the causes of a particular problem. Nancy argued that using this systematic method allowed her to "correct the problem not just the symptoms." Using Gilbert's model gave Nancy's analysis an organizing framework and allowed her to simultaneously consider a number of factors within the situation described in the case. Similarly, there were several interrelated pieces to her solution and she noted that, as her recommendations are implemented, "the workers might slow down a bit. But, this is likely to be only a temporary effect that would be more than offset by the increasingly safe working environment."

Nancy's strong response to this case may have been influenced by the timing of the case in relation to course content. The case was assigned immediately after the class read about and

discussed needs assessment, which included a discussion of Gilbert's model. Further evidence of the positive influence of the timing of the case is provided by the fact that several of the Undergraduate students made the connection between Gilbert's model and this case. In analyzing the case, 3 of the 5 (60%) students made specific reference to Gilbert's model and all 3 of those students had either a strong analysis or a strong solution.

A Weak Response

The results described above apply specifically to two of the three student groups. What about the third group (Graduate students, 1998)? How do the responses on their second case compare to these other two? This initial group of graduate students analyzed a different set of cases, so a one-to-one comparison isn't possible. However, responses from this group offer further evidence of the influence of feedback, case set-up, and context.

Of the 7 students in this group, only 2 (28%) produced either a strong analysis or strong solution to their second case, and neither produced both a strong analysis and solution. In contrast, 4 students (57%) produced a strong analysis and solution on their first case. These results might be explained by the absence of several of the factors that were present for the other 2 groups. First, this group did not receive feedback on their first case. Rather, the first case served as a pretest exercise, designed to acquaint students with the case-learning process and to provide the researchers with a rough measure of their pre-course problem-solving skills. Second, the case was presented in a very open-ended way, without the guiding structure that the other groups received. Finally, the students worked in teams for the first time on this case. In addition to analyzing the case and developing solutions, they had to work out the logistics and group dynamics involved in producing a team response. It is quite possible that these factors combined to produce a relatively low percentage of strong responses in this group of students. In contrast, feedback and a more structured case set-up were in place for the third case and the teams had, by then, had the opportunity to figure out how to work together. As a result, 5 of the 7 students (71%) produced either a strong analysis or solution, with 2 of the students (28%) producing a strong analysis and a strong solution. In addition, 4 of the 7 students in this group (57%) produced their strongest

response of the semester to this third case.

Although the examples above highlight how the presence of one factor (e.g., case set-up) led to a strong response while its absence led to a weak response, there are also examples (although fewer in number) of instances in which the presence of a seemingly positive factor (e.g., experience) may have led to a weak response. We describe a few of those instances below.

Experience. Occasionally students' previous experiences seemed to cause them to get "hung up" on the trivial details of a case or to become especially adamant about a particular solution because of the strong feelings they had about the issues in the case, or because of past successes with such a solution. For example, Sandra knew a lot about the content of the instructional module (Logo) being formatively evaluated in the Roger Wilson case. Although the issue in the case does not revolve around whether this was an appropriate topic for instruction, Sandra seemed to get sidetracked by this concern. She stated, "Logo is not used in elementary schools any more except in very rare cases (A sad truth). Has Roger or the instructor in any way tried to validate the need for Logo? Was it being used at the time this case occurred? A more important issue as far as ID might be concerned ... did they justify the learning of Logo to the students?"

Jerry's strong feelings about the topic of technology integration seemed to affect his ability to objectively look at the issues presented in the Antonio Mendez case. He wrote an entire paragraph justifying his beliefs, beginning, "First, a confession—I don't like the integration of technology into the elementary classroom." Jerry used his case response as an opportunity to "get on his soap box" and air his strong feelings about the topic, thus influencing his response in a negative way.

Coaching. For the most part, coaching seemed to have positive benefits for students in these courses. However, in a few instances, students appeared misled by a peer or colleague who provided their own "take" on a particular case. In one example, Sandra consulted with her college daughter about a case involving a college professor. Sandra's response to this case included one full page of comments based on her daughter's ideas. For example, she wrote, "The image of Tami (the instructor in the case) lecturing to her students caused a strong reaction from my daughter. Tami should vary her teaching with more discussions, group work, projects, and

discussion panels. My daughter says that lectures are boring and cause hand cramps! She also thinks Tami may be trying to be like the students. . . My daughter says teachers like that are considered 'weird!'" These comments appeared to deal more with what was wrong with the professor than with ways to frame and solve the specific ID issues. Thus, the "coaching" provided actually seemed to sidetrack Sandra; the underlying ID issues were not discussed.

Coaching from instructors has also been known to backfire, especially when used too enthusiastically, too early in the semester. In a couple of instances, graduate students (Spring, 1999) were noted to respond quite differently to listserv comments made by the instructor vs. comments made by a classmate. As an example, when Lois suggested an opposing viewpoint for the Frank and Semra case, her comment was subsequently incorporated into 4 of the remaining students' solutions. In fact, Mary noted, "I just read Lois' posting and had an 'aha' moment thanks to her comments." Yet when the instructor offered an opposing viewpoint related to one student's comment on a later case, the student responded in an apologetic manner, "I hope I did not offend you or anyone else with my comments." It is possible that instructor comments are perceived differently than those made by peers, suggesting that instructors need to be careful about when and how they participate in case discussions.

Case content. A number of students in the Spring, 1998 course indicated that the Julie Tatano case was confusing. Laura wrote, "I found this case not so well presented. Too many perspectives and issues were presented. While some seemed central to the case others appeared peripheral to me." In this case, Laura seemed to lose sight of the fact that real situations are often confusingly complex. Instead she seemed to say that the case was not presented in a way that she could understand. Perhaps for this reason, Laura's analysis and solution responses were weak. She spent more time restating the issues in the case, as opposed to "framing" them in terms of an underlying problem or principle. She included a bulleted list of recommended solutions, most of which were stated in fairly "directive" terms and few of which were linked to the issues: "All key stakeholders must meet . . . Julie must carry out a needs assessment." Thus, it appeared that specific components of this particular case study frustrated Laura, and perhaps distracted her from

focusing on the underlying issues in the case.

Case set-up. For both the Spring 1998 Graduate students and the Spring 1999 Undergraduate students, students' case responses were essentially structured around the same guidelines: 1) Describe your conceptualization of the issues in the case and 2) Propose recommendations to address the issues. However, for the Spring 1999 Graduate students, the case set-up varied from week to week. To keep the listserv discussion both interesting and lively, the instructor modified the weekly listserv directions so that different perspectives could be highlighted and different aspects of the case analysis process emphasized. For example, for the fifth case, students were assigned a role to play during the initial case discussion. Depending on which roles students were assigned, and how well they played them, this actually could have led to a "weak" response (using the previously defined criteria). For example, Chuck was assigned the role of Carlton Grove, the project manager for the client, in the Andrew Stewart case. Given his role, Chuck didn't make any suggestions for how to solve the current problem in the case, he simply suggested that the others "develop a plan of action to work through the issues to be resolved." He also noted that "I don't expect to be billed for the time already taken by the previous (botched) assessment." This response is completely in line with how the client "boss" might have responded. However, using our established criteria for "strong" and "weak" responses, this response was missing some important components--that is, there was no discussion of issues or related solutions. Although this type of case set-up seemed to enable students to consider other (less popular) perspectives in the case at hand, it may be important to combine this type of set-up with others previously described, to help students reflect on multiple dimensions of a case at a time.

Contextual factors. In addition to suggesting ways in which contextual factors may have had a positive influence on students' responses (as noted on the Lynn Dorman case above), we postulate that many of the contextual factors also may have had negative effects on students' case responses. For example, cases toward the end of the semester (Cases 5 and 6) tended to be fairly weak, especially compared to Case 4 which was fairly strong for all three groups. There are a number of factors that may have led to relatively weaker responses at this point in the semester (besides

factors described above) including increased commitments in other courses, decreased motivation due to continued use of cases, and additional outside influences (death in the family, interviewing for a new job, job responsibilities, etc.). It is important for instructors to be aware of these types of influences and, when possible, address those within their control.

Summary

This study was designed to examine changes in students' problem-solving skills during a semester-long course in which instructional design case studies comprised the primary instructional method. The results of this study support previous findings that suggest that the development of problem-solving skills does not follow a consistent linear pattern, with students simply moving forward on a novice-expert continuum. In general, students in this study showed both expert and novice characteristics throughout the semester. For example, some students demonstrated more expertise on an earlier case and less expertise on a later case. In addition, students showed different expert characteristics in response to different cases and different case set-ups.

These nonlinear patterns seem reasonable given that most of our participants had few practical experiences with instructional design. Their limited previous experiences did not provide them with the kind of extensive knowledge base that experts have or, more importantly, ways in which that knowledge can be applied in particular situations. As a result, expert performance wasn't internalized. The students could show expert characteristics at times, under some circumstances, but did not perform like experts on a regular basis. The primary influences on the incidence of expert performance seemed more external than internal -- a function of the type of case, specific case set-up, outside contextual factors, as well as the amount and type of coaching strategies utilized. Thus, students' expert performances might be more aptly characterized as "coached expertise" rather than independent expertise. Given these wide variations in students' performances, instructors may want to consider how to maximize their use of specific external influences to guide students' responses toward more expert-like approaches.

Implications

Although the generalizability of this study is limited by the small number of participants, it has important implications for both teachers and students who use case methods in their courses. If students and teachers are to truly benefit from participating in case-based learning experiences, they must be prepared to engage in meaningful case analyses and discussions (Meyers, 1986). Students can benefit from knowing effective strategies for analyzing issues and recommending solutions for discipline-related problems. Similarly, instructors can benefit from knowing effective strategies for coaching students during the case-learning process. With this in mind, we offer the following coaching strategies based on the results of this study. These are, of course, preliminary suggestions and it will be important to validate the benefits of these strategies with further research.

Diagnose and build on students' strengths. In a series of cases, use the first case (or two) to diagnose the students' relative strengths or preferences for analysis or solution. This was not explicitly done in this study. However, the results suggest that some students were better with analysis while others were better with solutions. For example, Jerry produced 5 strong analyses out of 6 cases, but only 2 strong solutions. In contrast, Kim produced 3 strong solutions out of 6 cases, but only 1 strong analysis. This information may be useful in selecting or developing case-learning activities. If a student's strength or preference can be determined at the beginning of a series of cases, then activities can be planned to build on that strength. For example, students who are initially stronger in analysis (like Jerry) can be asked to expand on their analyses, incorporating more aspects of the case into their analyses. With this as a foundation, they can be gradually guided into recommending solutions for a case. Likewise, students who are initially stronger in solutions (like Kim) can be asked to expand on their solutions, more fully considering how their solutions might be implemented and/or what impact those solutions might have. With this as a foundation, they can be gradually guided into analyzing a case.

Vary discussion activities. The activities that were used by the instructors in this study to generate dialog among the students included asking them to: (1) identify a major issue, possible causes, and a solution; (2) identify a set of issues and discuss the criticality of each issue; (3) plan

and conduct a meeting among the key players in the case; (4) take on the role of one of the stakeholders in the case and argue the case from that person's perspective; (5) engage in a "round robin" dialog in which each student comments on the suggestion made by the preceding student and then offers a suggestion of his/her own; and (6) invite an "expert" to participate in a case analysis with the students. This kind of variety helps maintain student interest throughout the semester. It also helps students develop different aspects of their expertise. For example, discussing the criticality of issues may be particularly useful in helping students think about the relationships among issues; assuming the role of one of the key players in the case might help students think about how their recommendations might affect other people; and a "round robin" type of dialog may help students critically evaluate solution ideas.

Provide a flexible discussion structure. Start case discussions with a structure, but avoid rigid adherence to that structure. The purpose of an initial structure, like those listed in the preceding paragraph, is to "prime the pump." It does this by providing the students with an initial shared framework for thinking about the case and expressing their thoughts. However, once the discussion starts and the ideas are flowing, the initial structure has served its purpose. In fact, students sometimes find it more constraining than facilitating. The teacher's tasks at this point are to help the students refocus the discussion when it begins to bog down, find the connections among the points made in the discussion, and encourage their high level of conceptualization by asking them to relate their discussion to the "big picture" issues in the case.

Start case discussions with "safe" questions. This is a particularly useful technique to use with relatively novice students who may not feel confident in their ability to analyze a case and may, therefore, be reticent in discussing their perceptions of the case. Asking "hard" or "risky" questions too soon may heighten students' anxiety about participating and lead to teacher-led and/or slow-moving discussions. As one way to avoid this, the instructor for the Undergraduate, 1999 course often began case discussions by asking students to recall the people and events in the case. This allowed the students to begin to discuss the case in relatively safe terms before taking the risk involved in interpreting those events or making suggestions about what to do in the

situation. The students were able to check their understanding of the objective facts of the case before testing out their more subjective interpretations of the case. With this kind of "safe" beginning, the students were able to move quickly from facts to issues on their own, with little prompting from the instructor.

Participate carefully in case discussions. The teacher can model expert behavior (for example, articulating a conceptual view of a case, looking for relationships among issues, or proposing and evaluating solution ideas). However, as noted earlier, students sometimes perceive comments from the teacher as the "answer," which may impede, rather than support, dialog. In these situations, it is often better to resist the natural tendency to add your own, more expert views and let the students come to their own understanding of a case and its solution. Of course, this doesn't mean that teachers should not participate in the discussion. It means only that teachers should be constantly aware of the potential effects that their participation may have on the students.

Limitations and Directions for Future Research

Although this research was designed to identify patterns in the development of students' problem-solving approaches what we found, primarily, was an absence of patterns. Besides the small number of participants, this may be due to other limitations including: 1) our analysis codes and categories were not sophisticated enough to find the patterns, 2) too many external variables were insufficiently controlled or accounted for in the study, and 3) an insufficient amount of time was allowed for the patterns to develop. Each of these options provide opportunities for future research.

One of the unstated goals of this study was to develop and apply an analysis framework for examining students' responses to discipline-based case studies. The framework developed as a result of this research, although greatly refined from its initial stages, must still be considered preliminary. Additional refinements are needed if we, and others, are to be able to apply it consistently while analyzing students' case responses.

This study was not designed to identify cause-and-effect relations. However, in trying to make sense of the results obtained, we suggested a number of reasons why students' responses varied as

they did. These suggestions are based on our own observations as course instructors, our familiarity with our students' specific situations, as well as unrecorded conversations with students during class discussions. We recognize that these do not constitute "hard data" and thus our interpretations should be considered preliminary. Future research might verify the influence of these, and other, factors on the development of students' problem-solving skills.

The development of expertise is known to take place over a long period of time. Trying to capture this development in a semester-long course is difficult at best. Longitudinal studies are needed to determine if, and how, this process occurs over an extended period of time, and the extent to which instructors can influence that process. Furthermore, it is important to determine the extent to which students who develop strong problem-solving skills within case-based courses actually transfer these skills to their future jobs. Does the experience of solving cases in a college course benefit instructional designers in their future practice? Further research is needed to address these important questions.

Conclusion

According to Ericsson (1996), the most important factor in the development of expertise is experience. Although the use of case studies can provide students with a forum for learning from their experience, "experience can only contribute to expertise if practitioners are capable of learning from it" (Kennedy, 1987, p. 142). By providing opportunities for students to explicitly utilize the problem-solving strategies that experts use, and by monitoring and guiding early and subsequent efforts, case instructors might more readily and effectively initiate students into "thinking like professionals." Furthermore, by refining our case-coaching strategies, case-based instruction can become a more powerful postsecondary tool for preparing students to become expert problem-solvers.

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Appendix A: Definitions and Examples of Analysis Categories

Category One: Problem Analysis

Conceptualization

Expert approach. Effort made to conceptualize, characterize, or prioritize the issues/problems; identification of the "key" issues; efforts to interpret issues/problems, rather than take them as given

Example. "I am basing my remarks on the productivity issue because I think in a manufacturing environment it all boils down to $$$. And I also think that to have any credibility as an instructional designer, you have to show that you understand how training and your role as a training designer can impact the productivity. In the Dorman case, I see the following issues:

1) increase in accidents leading to decrease in production hours while labor costs are remaining constant--increase in input
2) line speed has increased, but quality of labor is suffering (workers are getting careless)--decrease in output
3) new machines have been installed to improve quality control--are these new machines, methods improving quality as intended.

In summary, these factors suggest that input is increasing, but output is not, hence productivity is decreasing and that is not a good thing." (Mary, Case 2; Graduate, 1999).

Novice approach. Response to issues/problems as given; reporting or summarizing

Example. "Jim Huggins just received word that the multi-million dollar CBT program, which he proposed and designed, has failed:

- Only about 15% of the target audience used the CBT on a regular basis
- Engineers are more inclined to ask local experts for help rather than consult the CBT
- Process development leaders, who relied heavily upon the CBT to distribute information, were disappointed to find that their information was not getting out to the whole company.

Jim Huggins has to decide if there is anything he can do to salvage the project at this stage. This is very important to him, because the failure of the CBT will reflect heavily upon his work and reputation as an accredited Instructional Designer." (Margaret, Case 5; Undergraduate, 1999).

Search for Information

Expert approach. Focused forward ("What should I find out and why?"); requests for information are specific, goal-directed, and designed to extend existing information; what if... or if, then... hypotheses.

Example. "If the problem is that the employees are not wearing the proper safety equipment, Dorman ... should check accident reports and compare the use of safety equipment over the last six months to the use of safety equipment used in accident reports a year ago.

"The second reason might be the lack of proper training ... Dorman should talk to the employees directly on the plant floor.

"The third reason that there might be an increase in accidents is due to the increase in production ... Dorman should first go to the employees directly. Talk with them about how they feel about the increase and is it hindering their job performances." (Margaret, Case 2; Undergraduate, 1999).

Novice approach. Focused backward ("What information is missing?"); requests for information are general and aimed at what should be done in a generic sense.

Example. "In regards to an ID model, I find some of the key components are missing. For starters, Instructional Problems or Goals - why are they developing new training? How will they motivate learners if they do not know why they are training? How can content be determined without goals? There was no research put into Learner Characteristics - who the learners are, what they already know, or what motivates them." (Carolyn, Case 1; Undergraduate, 1999).

Systems Analysis (relationships among issues)

Expert approach. Effort to link issues/problems

Example. "These problematic conditions need to be considered individually to determine if they are related to the person, the facility, the agency, COMET, or any combination of the four. Once that is done, then we must determine how those four (components) relate to the various other barriers as a whole. For instance, are the hardware and software barriers truly problems, or are they of a user-, location-, or agency-generated nature? If it is determined that they are user-related, is it a lack of training on the equipment, a lack of understanding, apathy or some other factor?" (Tom, Case 1; Graduate, 1998).

Novice approach. No effort made to link issues; laundry list of unconnected problems/issues.

Example. In response to an analysis question asking students to: 1) list the barriers to successful use of the modules, 2) identify the most important ones and 3) develop a conceptual scheme, Jack listed the following (with no discussion and no apparent groupings):

1. Lack of time to go through modules
2. Lack of updated computer system
3. Lack of proper maintenance
4. Lack of appropriate and comprehensive design
5. Lack of relevancy
6. Lack of positive attitudes
7. Lack of administrative support
8. Lack of dedicated place for going through the modules
9. Lack of qualified personnel to administer the modules
10. Lack of leadership
11. Lack of effective award system.

Although these might have been grouped in numerous ways, the only grouping Jack made was to note that all but #6 related to administration issues; number 6 related to individual issues. Jack noted that the most important were #1, #3, #4, #7, #8, #10, yet gave no

explanation for this ordering. (Jack, Case 1; ; Graduate, 1998)

Category Two: Problem Solutions

Systems Analysis (relationship among solutions and between solutions and issues)

Expert approach. Effort to discuss recommendations in terms of their interdependence; links made between issues identified and solutions recommended.

Example. "Opening paragraphs indicate continuing positive acceptance of the goals as stated, a sound rationale for distance learning over centralized training, and a concern for the way the modules are not being used. (Thus) One possible solution (is): By networking the modules they can be accessed by any of the work stations at anytime. The forecasters can work with them during slow times without leaving their stations unmanned. This can help scheduling times and keep the stations manned as required. If the modules were shortened or segmented, reusing current resources and following the already successful format, the forecasters would need less time to finish them. They could also work on them in groups sharing ideas (taking advantage of the very cooperative way they collaborate). On-line help could be made available for common issues." (Sandra, Case 1; Graduate, 1998).

Novice approach. Solutions proposed independently of issues noted; relationship between solutions not described; "shotgun" approach to proposing solutions ("One of these is bound to work.").

Example. "There definitely needs to be a learner analysis that will show why there is a decrease usage of CBT. The following questions may be helpful:

- What are the learning style preferences?
- What are the learners' expectations?
- Are the learners there by choice or are they required to attend?
- What prerequisite skills do the learners possess?
- What are the limitations or handicaps of the learners? Is literacy a problem?"

(Joo, Case 5; Undergraduate, 1999).

Level of Commitment

Expert approach. Uses tentative wording (e.g., could, might); advisory in tone

Example. "There could be a few problems I guess, however, in my humble opinion, lack of teaching or instructional skills or techniques (which in my analysis includes grading policy and requirements) may be the heart of the problem. She meant well, but her grading policy and requirement may be outside of the students' ability and willingness to commit for the course. In other words, there is a mismatch between the instructional goal and the learner characteristics or entry behaviors. What I don't understand is that the course is a required junior/senior level course in a prestigious university, which indicates to me potentially a strong background of students. So maybe it's not the mismatch. If it's not then the problem I can assess for this case is either lack of instruction skills or students ganging up unfairly against the new instructor who imposes more work than what students are used to." (Jack, Case 4; Graduate, 1998)

Novice approach. Uses strong wording (should, must); dictatorial in tone

Example. "The agency must develop a program that is centered around forecasting. The time that is spent navigating through the other modules takes unnecessary time away from the forecaster's other responsibilities. The modules that are in place now simply are a waste of precious time." (Kim, Case 6; Undergraduate, 1999)

Consideration of Impact/implications

Expert approach. Explanation of implementation issues or tactics with some particulars; consideration of alternative effects; effort to anticipate possible consequences or effects; explanation or reasons or justification.

Example. "One format of the formative evaluation that could be considered is to randomly select ten percent of the employees at each of the nine plants and request their anonymous, confidential participation. This format would be relatively expensive due to the number of sites and facilitators required. A modified version of this format is to randomly select ten percent of the employees from one site to conduct the FE. This version would allow Ronda to conduct the FE without training other facilitators. While the cost would be lower, the depth of

information would not be as great. Some biases also might be present that could influence the quality of the results. These results would not be considered representative of all plants." (Scott, Case 2; Graduate, 1998).

Novice approach. Recommendations stated in generalities with little consideration of how they might be implemented or the impact they might have on the various stakeholders.

Example. "I would have each group meet outside of class to discuss any problem or misunderstanding of the lab... for further classes I would recommend that Sandra start to raise money for the department. She can do this by holding fund raisers. Also she can ask companies if they can donate equipment for an exchange of volunteer work for their company." (Nancy, Case 3; Undergraduate, 1999)

Table 1

Demographic Information for Participants (using pseudonyms)

Student	Age	Class	Prev Courses	Prev Exps
Sandra	50	Grad	Intro ID Advanced ID Interactive video Courseware Design Materials Design for Instr. Systems Seminar in ID	Training manager Jr High Sp Education teacher Assistant Coordinator--Resource center
Tom	41	Grad	Methods of Instruction Performance Evaluation Curriculum Development	Training Training Designer Course Development (college and industry)
Jack	37	Grad	Intro ID Curriculum Theory Seminar in ID	Marketing strategies Business strategies Computer lab coordinator and instructor
Jerry	32	Grad	Intro ID Interactive video Media for Education & Training Seminar in ID Instructional Design Theory	Business training Teaching-Technical College Develop courses, curriculum and materials
Scott	31	Grad	Intro ID Adult Delivery Systems Workshop Development	4H Youth Development

Table 1 (continued)

Laura	37	Grad	Curriculum Theory Organizational Leadership Organizational & Ind Psych	Science teaching Sci & Tech curriculum dev
Tammy	41	Grad	Intro ID Media for Education & Training Adult Delivery Systems	Human Resources employee MS-Counseling/Personnel BA-Secondary Ed
Cindy	27	Grad	Intro ID	Teaching HS Japanese Developing Japanese curricula
Mary	37	Grad	Intro ID Developing Instructional Materials for Industrial Tech ID Research Instructional Strategies Seminar in ID Internship in ID	Training Manager Asst Director of Admissions Asst Director of MCATE
Veena	32	Grad	Intro ID ID Research Seminar in ID	Foreign Language Instructor
Lois	49	Grad	Intro ID Theories of ID Internship in ID Integration and management of computers	Developed courses for nursing program at university Developed health ed programs for Planned Parenthood
Ted	28	Grad	Intro to Educational Technology Computer Assisted Instruction	Jr. High Math teacher Computer Science instructor Media specialist web master

Table 1 (continued)

Chuck	26	Grad	Intro ID Principles of Adult Education Proj. Mngr in Tech & Industry	Quality Assurance analyst, Quality engineer
Jane	24	Grad	Intro ID Media for Ed & Trng Seminar in ID Curriculum Design	HS Social Studies Teacher
Nancy	23	UG	Intro ID	No information provided
Joo	22	UG	Intro ID	Retail sales Developed Bible study materials for teenage audience
Carolyn	21	UG	Intro ID	Retail sales and customer service Trained new managers for Boston Chicken Developed "fact and procedure" sheets for current retail sales employer
Kim	23	UG	Intro ID	Administrative and financial assistant. Currently works in Human Resources
Margaret	24	UG	Intro ID	Clerical worker Works as a customer service rep Has conducted informal training